

REMARKS

Favorable reconsideration of this application, as amended, is respectfully submitted.

A new abstract has been provided as required.

Applicants respectfully request reconsideration of the assertion that Figs. 3A and 3B should be designated as "Prior Art". It is not certain that Fig. 3A qualifies as prior art to claims of the present application under the Patent Statutes. Perhaps the legend "Background Art" could be applied to Fig. 3A.

Applicants are of the opinion that Fig. 3B should not be designated as "Prior Art", because that figure illustrates a discovery by the present inventors that the output voltage shows a reducing tendency when the power source voltage is equal to or higher than 3.7V through 4V. See page 4, lines 5-8 of Applicants' specification.

Claims 1, 2, and 3 have been amended to recite a forward base current. Thus, Claim 1 now recites, inter alia, "wherein when a forward base current produces an amount of an overcurrent exceeding a previously set value,

by detecting the amount of the overcurrent and subtracting the amount of the overcurrent from the base current, an increase in a collector current of the amplifying element is restricted".

Claim 2 now recites, inter alia, "a protecting circuit constituted such that when a forward base current of the bipolar transistor exceeds a predetermined value, a current having an amount of exceeding the predetermined value flows from the bias circuit to the protecting circuit".

Claim 3 now recites, inter alia, "a protecting circuit for detecting that a forward base current of the bipolar transistor exceeds a predetermined value and subtracting a detected amount of exceeding the predetermined valued of the base current from the base current".

These claims, as well as Claims 4-16, which depend directly or indirectly upon Claim 2, clearly distinguish patentably from the prior art relied upon in the rejections under 35 U.S.C. §§ 102(b) and 103(a).

Applicants' invention has a protective function that relies on a forward base current. The protective function of Prentice, the principal reference, relies upon a reverse base current related to a phenomenon known as avalanche multiplication. See, e.g., column 1, lines 46-49; column

2, lines 13-18 and 58-62; column 3, lines 43-47; column 4, lines 29-35 and 53-55; column 4, line 67 to column 5, line 3; column 5, lines 10-14 and 44-47; and column 6, lines 4-7.

Contrary to Applicants' invention, in Prentice the invention is intended to protect a bipolar transistor in the case of operating at the operating point near the avalanche breakdown area. Prentice discloses a circuit configuration that addresses avalanche breakdown, which is caused by fluctuation of the operating point, by detecting the reverse base current which flows out from the base due to an avalanche breakdown.

In RF operation addressed by Applicants' invention, for example, breakdown would occur near the half current of the SOA limit of DC. This base current is a forward-direction base current, not a reverse direction current as in Prentice.

Applicants' invention improves tolerance to load fluctuation, while Prentice aims at increasing tolerance of amount of V_{CE} , unlike Applicants' invention.

The deficiencies of Prentice are not compensated by the secondary references, so that even if the reference teachings were combined as proposed in the rejection under

35 U.S.C. § 103(a), Applicants' invention would not be produced. Accordingly, all of the claims should be allowed.

Minor clarifying amendments have been made in Claims 1, 3, 5, 6, and 12. These amendments are not responsive to the rejections and do not affect patentability of the claims.

Marked-up copies of the amended claims and the Abstract are attached.

Merely for completeness of response, it is noted that the second complete paragraph on page 4 of the Office Action is incomplete, that the text of the rejection of Claims 12-14 on page 6 of the Office Action relies upon the Masashi et al. not mentioned in the basic rejection in paragraph 7 at the bottom of page 4, and that Chiozzi (U.S. Patent No. 5,917,382) referred to at the bottom of page 7 as "not relied upon" is in fact relied upon in the rejection under 35 U.S.C. § 103(a).

This application is now believed to be clearly in condition for allowance.

The Commissioner is hereby authorized to charge to Deposit Account No. 50-1165 any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this paper and to

credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been requested separately, such extension is hereby requested.

Respectfully submitted,

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ABSTRACT OF THE DISCLOSURE

A power amplifier module is provided with a function of protecting an amplifying device against destruction caused by a standing wave by reflection from an antenna end in load variation. Forward overcurrent flowing at a base of a final stage amplifying portion GaAs-HBT in load variation is detected and canceled and collector current is restrained to thereby prevent an increase in output and prevent destruction of GaAs-HBT. By also using a function of successively lowering idling current when power source voltage is elevated and a clipping function of diodes connected in parallel with output stage GaAs-HBT, voltage as well as current more than necessary are avoided from being applied on the output stage GaAs-HBT.

Marked-up Copy of the Abstract:

ABSTRACT OF THE DISCLOSURE

[There is provided a] A power amplifier module [which] is provided with a function of protecting an amplifying device against destruction caused by a standing wave by reflection from an antenna end in load variation[, having a high tolerance level of device destruction and is highly efficient]. [Overcurrent] Forward overcurrent flowing at a base of a final stage amplifying portion GaAs-HBT in load variation is detected and canceled and collector current is restrained to thereby prevent an increase in output and prevent destruction of GaAs-HBT. [Further, by] By also using a function of successively lowering idling current when power source voltage is elevated and a clipping function of diodes connected in parallel with output stage GaAs-HBT, voltage as well as current more than necessary are avoided from being applied on the output stage GaAs-HBT.

[The tolerance level of device destruction of the power amplifier module can be promoted and device destruction in load variation can be prevented. Further, influence of a current amplification rate of GaAs-HBT on production deviation or temperature variation can be

reduced and high production yield can be achieved, which accordingly can contribute to low cost formation.]

Marked-up Copy of the Claims:

1 1. (Amended) A power amplifier module which is a
2 power amplifier module using a bipolar transistor as an
3 amplifying element, wherein when a forward base current
4 produces an amount of an overcurrent exceeding a previously
5 set value, by detecting the amount of the overcurrent and
6 [subtracting] subtracting the amount of the overcurrent
7 from the base current, an increase in a collector current
8 of the amplifying element is restricted.

1 2. (Amended) A power amplifier module comprising:
2 a signal amplifying portion including at least a
3 bipolar transistor as an amplifying element and amplifying
4 and outputting an input signal;
5 a bias circuit for providing an idling current to the
6 signal amplifying portion; and
7 a protecting circuit constituted such that when a
8 forward base current of the bipolar transistor exceeds a
9 predetermined value, a current having an amount of
10 exceeding the predetermined value flows from the bias
11 circuit to the protecting circuit;

12 wherein by making the amount of exceeding the
13 predetermined value of the base current flow to the
14 protecting circuit, an output of the signal amplifying
15 portion is restricted to be equal to or smaller than a
16 predetermined value.

1 3. (Amended) A power amplifier module comprising:
2 a bipolar transistor for amplifying and outputting an
3 input signal; and
4 a protecting circuit for detecting that a forward base
5 current of the bipolar transistor exceeds a predetermined
6 value and [subtracting] subtracting a detected amount of
7 exceeding the predetermined value of the base current from
8 the base current:

9 wherein by controlling the base current of the bipolar
10 transistor by the protecting [means] circuit, a collector
11 current of the bipolar transistor is restricted to be equal
12 to or lower than a predetermined value.

1 5. (Amended) The power amplifier module according to
2 Claim 2, wherein the bias circuit includes a current source
3 and a transistor and the transistor constitutes a current

4 mirror circuit along with another transistor connected in
5 series with the current source.

1 6. (Amended) The power amplifier module according to
2 Claim 2, wherein the protecting circuit includes a first
3 transistor, a first resistor connected to a base of the
4 first transistor, a second resistor one end of which is
5 connected to an emitter of the first transistor and another
6 end of which is connected to the first resistor, a second
7 transistor connected to a collector of the first transistor
8 and a third transistor constituting a current mirror
9 circuit along with the second transistor and connected to
10 the bias circuit.

1 12. (Amended) The power amplifier module according to
2 Claim 2, further comprising:
3 a plurality of stages of the amplifying elements
4 connected in series with each other;
5 wherein at least the amplifying element at a final
6 stage is protected by the protecting [means] circuit.